

ATEC's Approach to Integrated Testing

James J. Streilein, Ph.D and N. Dianne Luna
U.S. Army Test and Evaluation Command, Alexandria, Virginia

Integrated testing is not new to anyone in the acquisition/testing field. When asking members of the Service testing communities if they are doing integrated testing, the reply is almost always going to be affirmative. With that said, what do they mean by integrated testing? Historically, different people have offered different definitions.

Key words: ATEC System Team; Ballistic Missile Defense System; combined DT/OT; coordination; integrated DT/OT; planning testing strategy.

In an effort to provide a common point of reference, the Office of the Secretary of Defense (OSD) provided a definition of integrated testing to the Services in 2008. They defined it as

"...the collaborative planning and collaborative execution of test phases and events to provide shared data in support of independent analysis, evaluation and reporting by all stakeholders particularly the developmental (both contractor and government) and operational test and evaluation communities." (OSD, 2008)

U.S. Army Test and Evaluation Command (ATEC) has further refined this definition to obtain a better understanding of where we can go beyond integrated testing. When talking about integrating testing, ATEC uses the terms "Integrated" Developmental Test and Operational Test (DT/OT) as well as "Combined" DT/OT. Integrated DT/OT, a special case of a Combined DT/OT, is a single-phased event that generates data to address developmental and operational issues simultaneously under operational conditions. The execution strategy for this event is based on the requirements of the program. Combined DT/OT is a single event that produces data to answer developmental and operational system issues. A Combined DT/OT is usually conducted as a series of distinct DT and OT phases at a single location using the same test items. For the case in which a single phase can be used to simultaneously meet developmental and operational issues, this testing will be referred to as an Integrated DT/OT. Combined DT/OT and Integrated DT/OT are encouraged to achieve time, cost, and resource savings. However, they must not compromise DT and OT objectives in accordance with the Defense Acquisition Guidebook.

Roadmap

ATEC has the distinct advantage among the Service Operational Test Agencies (OTAs) of having the developmental testers, operational testers, and the system evaluators all organized under one command. ATEC utilizes a highly effective team structure for each evaluated system. This team structure is labeled the ATEC System Team (AST). The team is composed of personnel from each subordinate command activity (SCA) within ATEC. The core members include the developmental tester, operational tester, and the evaluator. The AST has a Chair who is the command's lead person on that system.

The AST plans, manages, and coordinates test and evaluation (T&E) for assigned systems. An AST is established upon notification of a new requirement from any source or receipt of justification for new requirements. The office of the ATEC Deputy Chief of Staff for Operations coordinates the formation of the ASTs across ATEC.

The AST identifies and resolves system T&E issues and, when necessary, elevates unresolved issues up through the chain of command. The AST presents a single coordinated ATEC position at the T&E Working-level Integrated Product Team (T&E WIPT) meetings. The AST has many responsibilities. For example, the AST is responsible for the synchronization and integration of all ATEC efforts for the assigned system; speaks with one voice when interacting with organizations outside ATEC; reviews all requirement documents, request for proposals, and statement of works. The AST Chair leads all AST activities.

The AST members (both testers and evaluators) are involved early in the T&E planning activities in order to offer their expertise and begin identifying resource requirements. The AST ensures the T&E strategy is

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE SEP 2009		2. REPORT TYPE		3. DATES COVERED 00-00-2009 to 00-00-2009	
4. TITLE AND SUBTITLE ATEC's Approach to Integrated Testing				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Test and Evaluation Command, 4501 Ford Ave, Alexandria, VA, 22302-1458				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 5	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

aligned with and supports the approved acquisition strategy, so that adequate, risk-reducing, nonredundant gathering of T&E information is provided to support decision events.

The evaluation strategy typically utilizes ground test activities, where appropriate, to include hardware-in-the-loop simulation, prior to conducting full-up system-level testing in realistic environments. The required technical progress includes reliability, desired capabilities, and satisfaction of critical operational issues and criteria to mitigate technical and manufacturing risks. This will increase the likelihood of operational testing and evaluation (OT&E) success by testing in the most realistic environment possible. In addition, the AST will assess system-of-systems command, control, communications, computers, intelligence, surveillance, and reconnaissance prior to operational testing to ensure that interoperability under representative load conditions will represent stressed OT scenarios.

The AST must keep ATEC and the SCA leadership informed by conducting a series of management reviews of planning, progress, and results; continually updating program status and milestones in the ATEC Decision Support System.

Methods/processes

Planning for T&E begins at the earliest stages of the development of user needs, science and technology, system requirements, development, and acquisition processes. Evaluators on the AST participate in the Integrated Concept Development Team review of the Initial Capabilities Document when a new system or new technology is being considered for development.

By policy, every T&E strategy will collaboratively plan all testing and Modeling and Simulation (M&S) activities as an efficient continuum to include appropriate use of integrated/combined testing. Both developmental and operational testers, in concert with the system evaluator, assist the Materiel Developer (MATDEV) and Combat Developer in credible events as appropriate to the program. Early involvement can significantly reduce test time and cost through comparative analysis, data sharing, and use of all credible data sources.

The primary purpose of the T&E WIPT is to optimize the use of appropriate T&E expertise, test assets, targets, instrumentation, facilities, simulations, and models to achieve test integration, thereby reducing costs to the Army and decreasing acquisition cycle time. The T&E WIPT supports the collaborative T&E strategy, resolves issues, and assists the Program Manager (PM)/MATDEV in developing and coordinating the Test and Evaluation Master Plan.

Expectations

What is expected by the overall acquisition community with the increase of integrated testing? Program Executive Officer (PEO)/PMs expect to save time and money. Because of that, integrated testing is very attractive to them. However, with this type of integrated DT/OT, it is very unclear (from the tester's perspective) who is in charge of the planning, execution, and reporting.

Current OSD guidance is that developmental and operational test activities shall be integrated and seamless throughout the system's life cycle. This guidance is understood, but very difficult for test agencies to implement due to the lack of resourcing. OSD expects better results from the systems acquisition as demonstrated via higher pass rate in initial OT&Es.

Challenges

- Approval of plans—Director OT&E approves operational test plans but they only provide advice on developmental testing. With an integrated DT/OT, who would approve the plans?
- Changing cultures—Traditional ways of planning, executing, and reporting test events must change into a more cohesive and cooperative process. How do we decide who is in charge of each test event?
- Competition for services between the test centers—If both DT and OT assets are being used for test events, will there be enough assets to fulfill DT-specific or OT-specific events?
- Maintain the “independent” evaluator—Will the evaluator be able to remain independent if they are integrated into the developmental cycle early in the process?
- ATEC's early involvement in DT—Challenges to ATEC's early involvement (DT) need to be overcome (for example, negative OTA perception by the PMs and increased personnel and funding requirements). How does ATEC convince PMs that being involved early will help the process, not hinder it?

Benefits/lessons learned

The acquisition community needs to be aware that early involvement by ATEC leads to a high return on investment ROI for the PM. ATEC has proven this by having success after success with acquisition programs. Over the past few years, ATEC has many success stories where early involvement by the testing organization has saved time and money for the PM.



Figure 1. M915A5: In an effort to gain early operational feedback, two 88M Soldiers accompanied test drivers on the cross-country drive from Portland, Oregon, to testing grounds at Aberdeen Proving Ground (APG), Maryland. Each M915A5 (above) was instrumented in order to fully utilize all mileage in the final reliability evaluation.

Examples

The following examples of ATEC's approach to integrated testing provide a clear understanding of the above policy statements:

1. The M915A5 is a commercial purchase standard acquisition of a line haul semi-tractor with some add-on military equipment for fittings for up-armoring packages (Figure 1). The M915A5 T&E program will start with a cross-country drive from the West Coast manufacturer to Aberdeen Proving Ground, Maryland, on the East Coast. DT instrumentation and data collection will be utilized before delivery to the DT location. During the DT, the reliability/durability testing will be accomplished to the operational mode summary/mission profile usage with a mix of civilian and military drivers. There will be a traditional pure OT, but reliability data from both the developmental and operational testing will be used in the evaluation of reliability and durability, thereby allowing a reduction of the OT miles to fewer on each truck than possibly needed to address reliability.
2. On rapid acquisition programs, in comparison to traditional acquisitions, ATEC ordinarily can only get a very limited single test in one location. For example, the initial Mine Resistant Ambush Protected (MRAP) vehicle programs had a very limited functional checkout as opposed to a full DT, a very limited user operational period fit in around the DT schedule and a parallel set of survivability sets (Figure 2). Based on an integrated assessment by ATEC and U.S. Marine



Figure 2. Mine Resistant Ambush Protected (MRAP): Military Subject Matter Experts from the U.S. Army, Marine Corps, Air Force, and Navy assisted Army Test and Evaluation Command (ATEC) providing ground personnel at Aberdeen Test Center (ATC) in generating data for the early assessment of the MRAP vehicles.

Corps Operational Test and Evaluation Agency, MRAP decision makers were able to decide which specific variants to buy and field in specific quantities. Based on continuing cycles of buying, testing in both DT- and OT-like environments, as well as Theater usage as reported by the ATEC Forward Operating Assessment team; MRAPs have been continually produced, improved, tested/evaluated, fielded, and had field feedback leading to what is viewed as a success story in quickly increasing Soldier survivability. Of course this quick reaction approach also has had negative consequences in which the field has experienced problems that would have been found and fixed via a more standard testing approach. These realized risks have had an even larger impact because of the many variants of models from different manufacturers that have been fielded.

3. Certainly the most integrated T&E program being worked by ATEC is for the Ballistic Missile Defense System (BMDS) (Figures 3 and 4). The BMDS is a system-of-systems made up



Figure 3. Ballistic Missile Defense System (BMDS): U.S. Army Test and Evaluation Command (ATEC) is the lead of a multi-service Operational Test Agency (OTA) providing an independent operational report of the integrated BMDS capability to defend the United States, its deployed forces, friends, and allies against ballistic missiles of all ranges and in all phases of flight. (Approved for Public Release 2009 MDA Book).

of developmental programs, upgraded programs to existing programs, and integration of existing systems. A list of the BMDS currently fielded systems includes Ground-Based Mid-course Defense (GMD), Aegis BMD Surveillance and Track Destroyers, and Sea-Based X-Band (SBX) radar. Some BMDS systems fielded for defense against Regional/Theater ballistic missions are Aegis Engagement Cruisers and Destroyers with Standard Missile-3 (SM-3) interceptors and Patriot PAC-3. The Theater High Altitude Area Defense system is being developed and tested under BMDS. The BMDS has been removed from the normal acquisition rules by an act of Congress. However, as the lead OTA, ATEC, with support of the other involved Service OTAs, has developed a fully integrated T&E approach, which is making use of collaborative testing on multiple occasions. The BMDS will be fielded in capability sets and each capability set has a planned T&E campaign that is built from pure DT events, operationally realistic events, partial OT events with real users in the loop, pure OT ground and flight test periods,

and real users in real operational periods leading to final user acceptance as a mission capable war fighting system.

Summary

An integrated or combined testing approach may offer an effective means of shortening the time required for testing and may achieve cost savings. However, when this approach is used, it is imperative that extensive coordination is done well in advance of the event in order to ensure all (DT and OT) requirements are addressed. The utilization of the AST and the T&E WIPT can help with this coordination by providing mutual support and sharing mutual beneficial data across the acquisition community. Every commodity area, every system, and every system phase needs a tailored T&E program. Every T&E program ought to be looked at to see if the best mix of separate, integrated and collaborative testing has been built into the program. ATEC early T&E planning reviews take a serious look at each program from an integrative approach to T&E. ATEC lessons-learned have shown the value of this approach. We expect to make further advances on this path in the

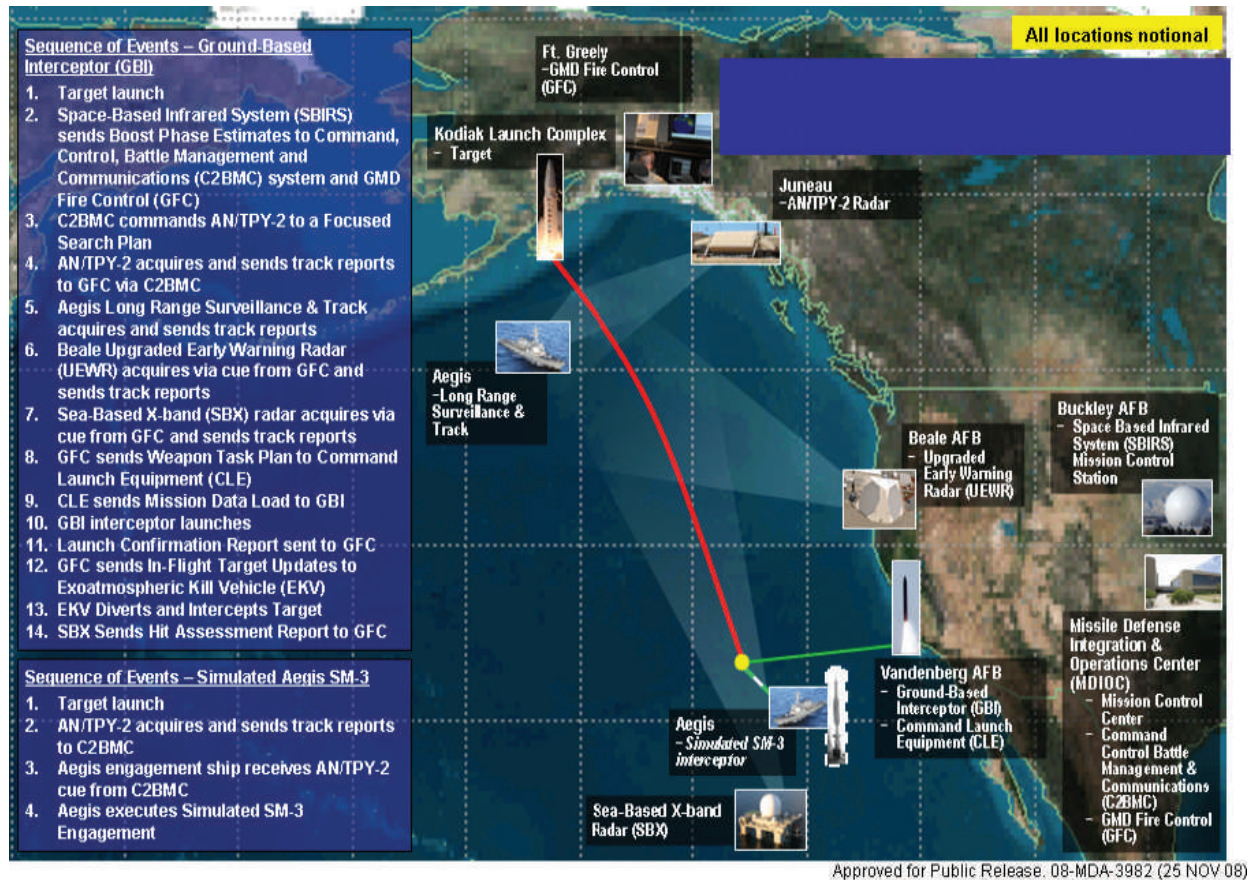


Figure 4. Integrated Developmental Test and Operational Test (DT/OT).

future. As discussed, there are difficulties in fully achieving integrated testing. However, as a community of acquisition and T&E experts, there is no doubt we will be able to make substantial progress toward our ultimate goal of providing systems to our soldiers that are proven to meet requirements within established time and cost constraints. □

N. DIANNE LUNA has been a policy analyst at the U.S. Army Test and Evaluation Command (ATEC) since October 1996. She earned a bachelor of science degree in management and business from National-Louis University, Evanston, Illinois. Mrs. Luna has over 30 years of federal service with emphasis on organizational and technical analysis, planning, policy, compliance, and implementation of military issues and/or programs. E-mail: dianne.luna@us.army.mil

JAMES J. STREILEIN, Ph.D., has been the executive technical director/deputy commander, of the U.S. Army Test and Evaluation Command (ATEC) since April 2007. He

earned a doctor of philosophy degree in mathematics from Pennsylvania State University, University Park, Pennsylvania, and a bachelor of science degree in mathematics from Carnegie Mellon University, Pittsburgh, Pennsylvania. Dr. Streilein provides oversight and technical direction to all command efforts to include testing, evaluation, modeling and simulation, and instrumentation. Dr. Streilein has over 35 years of federal service starting from 1974 to 1996 at the U.S. Army Materiel Systems Analysis Activity (AMSAA) in a variety of technical and managerial positions. He became a member of the Senior Executive Service in August 1991 upon selection as the Chief, Reliability, Availability, and Maintainability Division of AMSAA. In the 1996 reorganization of Army test and evaluation, Dr. Streilein was selected as the first director of the Evaluation Analysis Center (EAC) of the Operational Test and Evaluation Command (OPTEC). In September 1999, the Army reorganized test and evaluation and Dr. Streilein was selected as the first director of the newly formed Army Evaluation Center (AEC) of ATEC. E-mail: james.streilein@us.army.mil